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UNITED STATES
DEPARTMENT OF
AGRICULTURE

FOREST
SERVICE

RO

REPLY TO: 3420

DATE: JUN 0 2 1988

SUBJECT: Pest Management Input to EIS for Grider Burn, Oak Knoll R.D. (Report. No. 88-13)

TO: Forest Supervisor, Klamath N.F.

The Oak Knoll Ranger District is in the process of preparing an Environmental Impact Statement to assess various alternatives for recovery of the Grider Creek Drainage. A significant portion of the drainage burned in September, 1987. The District requested specific input to a number of questions about insects and diseases in the burn. The area was examined by Dave Schultz, entomologist, James Allison, pathologist, and Carl Varak from the District on April 28, 1988. The format of this report reflects the specific nature of the information requested.

I. Affected Environment. The Grider Creek drainage lies north of the Marble Mountains wilderness and south of the town of Seiad Valley on State Highway 96. The drainage is largely unroaded, although it is bounded by roads on the east, north and west. All affected land in the drainage is part of the National Forest System, with the exception of a 40 acre private parcel. The private parcel is isolated, although it is connected to existing roads by a skid trail constructed to harvest timber from the parcel.

The Pacific Crest Trail parallels Grider Creek through the drainage. A human-caused fire started near the Pacific Crest Trail on July 17, 1981, and burned eastward through T. 45N., R. 12W., Sec. 21 and 22 MDM toward Rancheria Creek. The Burn covered about 400 acres with 250 acres of almost complete kill. Because of litigation, salvage and rehabilitation were not done.

Elevations within the area of the drainage affected by the 1987 burn range from under 2,000 feet to over 6,000 feet. The vegetation throughout the drainage can generally be described as mixed conifers with associated hardwoods. At the lowest elevations, the stands are generally Society of American Foresters Forest cover types 234 (Douglas-fir - tanoak - madrone) or 244 (Pacific ponderosa pine - Douglas-fir). At the highest elevations, stands most closely resemble SAF types 207 (red fir) and 211 (white fir). Coniferous species common to many parts of the drainage include Douglas-fir ponderosa pine, sugar pine, white fir and incense-cedar. Common hardwoods include madrone, canyon live oak and bigleaf maple. Although there have been few human activities in the drainage, the stands are a mosaic of size, ages and species.

There are also few concentrations of trees older than 250 years, indicating there have been a series of fires in the past, some of which were severe.
Native conifer diseases endemic to the area include Douglas-fir dwarf mistletoe,

Arceuthobium douglasii, white fir dwarf mistletoe, Arceuthobium abietinum f. sp concoloris and annosus root disease in white fir, Heterobasidium annosum. . The normal role of dwarf mistletoes is to reduce annual growth and vigor of the host. Although it is rare for dwarf mistletoe to kill a tree by itself, a substantial proportion of trees which die during drought periods have been previously stressed by moderate to severe dwarf mistletoe infections. Dwarf mistletoes are commonly perpetuated when infected overstory trees remain to infect the regeneration after a stand is partially removed by fire or harvest. The role of annosus root disease in white fir is primarily as a root and butt rot. When trees are growing rapidly, new wood and roots are added faster than they decay. If trees slow down because they are stressed by competition, drought or fire injury, enough roots may be decayed to cause the tree to be susceptible to bark beetles or blowdown. The most common entry court for annosus root disease in unmanaged true fir stands is through basal wounds caused by fire. In managed fir stands the most common entry court is through mechanical wounds near the ground.

An introduced disease common in the area is white pine blister rust, Cronartium ribicola. It has been present on the Klamath N.F. since the 1930's. It has a complex life cycle which involves alternate hosts; five-needled pines and Ribes spp. (currants and gooseberries). The major host of concern in the Region is sugar pine. The fungus infects through the new needles and will grow down the branch to form a canker.

Depending on the distance of the infection from the bole, it will either girdle and kill the branch, or girdle and kill the tree. A small percentage of the sugar pine population has natural resistance to the disease. There is a Region-wide program to identify and eventually breed sugar pine resistant to blister rust. The burn eliminated many of both alternate hosts of blister rust in the drainage. Because Ribes seeds are stimulated to germinate by disturbance, it should increase in abundance very quickly.

A number of common bark and engraver beetle and borers are usually present at low numbers in the Grider Creek drainage, these include:

Common Name	Scientific Name	Host
Douglas-fir engraver	Scolytus unispinosus	Douglas-fir
Fir flatheaded borer	Melanophila drummondi	Douglas fir, true firs
Western pine beetle	Dendroctonus brevicomis	Ponderosa pine
Pine engraver beetles	Ips spp.	All pines
California flatheaded borer	Melanophila californica	All pines
Mountain pine beetle	Dendroctonus ponderosae	Sugar pine (also ponderosa lodgepole and western white)
Fir engraver	Scolytus ventralis	red and white fir

These beetle are able to maintain populations in an area in trees which are severely suppressed, struck by lightning, diseased, injured by soil movement, fire scorch, fluctuating water table, or other type of disturbance. The Douglas-fir engraver and pine engravers are capable of breeding in green host material which has been cut or broken from a tree. All of these beetles have some potential to build up in an area if large numbers of trees have been made susceptible by a widespread environmental factor such as drought or fire scorch. There is usually limited movement of beetles into or out of a given area, but instead, the resident population will build in place in response to increased habitat (stressed trees) and decrease after the available habitat has been exploited.

Most, if not all, of the Grider Creek drainage has been under severe water stress during the 1986-87 and 1987-88 water years (Oct. 1 - Apr. 30) (Figure 1). The nearest weather station is at Happy Camp Ranger Station, about 9 air miles to the west. There are undoubtedly some differences in the absolute amounts of precipitation received at Happy Camp and the Grider Creek drainage, but the pattern is probably similar. The same dry weather during the 1986-87 water year which led to intense fire conditions also made many trees susceptible to bark beetle attack during late summer, 1987. In most cases, attacks took place before any fires occurred both in areas which later burned as well as outside the area which burned. In some cases, the attacked trees began to fade as early as February, 1988 although others may not fade until June. The effects of these attacks are quite difficult to detect in the burned areas. In areas where the fire was intense enough to kill most of the trees, the heat was also intense enough to kill the beetles under tree bark. In areas where fire was less intense, it is hard to distinguish at any distance between scattered beetle-killed trees and scattered fire-killed trees. Regardless of the difficulty of detecting bark beetles in the area, there appears to be an adequate supply of beetles to occupy a significant portion of living trees severely stressed by fire injury and/or drought.

Severe lightning storms in late August and early September started many fires on the Klamath N.F. Some fires eventually burned together and coalesced. A fire from the ridge on the east side of Grider Creek and one from the west both burned down into the drainage. The downhill nature of the burn, combined with a strong inversion layer and low fuel moisture, produced some unusual patterns of burn intensity. At least 15,000 acres have been affected to some degree. There has been an ongoing effort by the District to map the burn intensity. Areas have been mapped as high intensity, in which virtually all vegetation was killed; medium intensity, in which there is a mottled appearance of live and dead vegetation; and light intensity, which generally appears to be an underburn with only occasional dead trees. As the weather warmed during the spring of 1988, additional trees have faded in the medium and light intensity areas. Although some of these trees showed little outward sign of serious injury, cambial injury was severe enough that the trees have basically been dead all winter. This situation might be compared to that of a freshly cut Christmas tree which appears remarkable healthy until exposed to several weeks of warm, dry conditions. The last of the green-crowned, fire-killed trees should have faded by June or early July, even at the highest elevations. During the summer of 1988, bark and engraver beetle and flatheaded borer adults will emerge in the Grider Creek drainage and search for host trees under stress. Because the last two winters have had significantly lower than normal precipitation, most of the trees in the drainage will be under some moisture stress.

The probability of beetle attack will increase with the number of other stress factors affecting the trees. Factors which could be important include recent sudden exposure, such as isolated trees or along edges of severely burned areas; significant damage to the cambuim and/or crown; stocking levels approaching or above normal based area; and moderate to severe dwarf mistletoe infections.

Depending upon the tree species, tree size and species of beetle involved, the trees may fade as early as August, 1988 or as late as 1992.

II. Environmental Consequences.

Alternative A - No Action

This alternative would do nothing in the planning area. No timber harvest, roading, or recovery projects would be done. The area would be left as is.

The probable course of events if no action is taken in the drainage can be portrayed in a qualitative way. In the severely burned areas, scattered hardwood trees and brush have begun to sprout from root crowns. Where these develop from well established root systems, the plants will have a competitive advantage over vegetation that develops from seed. Some forbs and grass are germinating in places. There are some isolated living (but injured) trees within many severely burned areas. If they live, some of these trees will produce an abundant crop of cones in response to stress. This may result in some restocking of conifers in the area, although the prospects will diminish rapidly with the passage of time. The bare mineral seedbed which existed shortly after the burn has already been covered with a layer of fallen leaves and needles, competing vegetation is already developing in spots, and some of the potential seed trees have a high probability of dying before the 1988 cones can fully ripen. A few isolated trees or stringers may survive for decades, but most should be expected to die within the next few years. The greatest chances of survival would be at the highest elevations, on north slopes and along ephemeral or permanent water courses. If the trees are infected with dwarf mistletoe and survive longer than about 10 years, they can also provide an infection source to susceptible tree species which seed in near them.

Scattered mortality over the next few years should also be expected along the edges of severely burned areas. For a distance of 50 to 100 feet inside the living stand, the growing conditions for trees have often been altered by various combinations of cambial damage, crown scorch, change in root environment by consumption of duff, root killing or injury by heat, change in amount of radiant energy and evapotranspiration after stand opening, and sunscald.

Depending upon the distance from a suitable seed source and seedbed conditions, some severely burned areas may have immature stands of timber in as little as 60 years, while other areas are still brushfields waiting for a seed source to "leapfrog" close enough to be of use.

The moderately burned areas are a mosaic of small patches of severely burned areas and small patches of fire injured trees. This produces a very large area of "edge effect", resulting in extensive, scattered mortality which will be prolonged over a period of years. A disproportionate amount of hardwoods and brush will probably survive because of differences in the nature of the beetles which attack broadleaf plants and conifers, as well as the ability of many woody broadleaf plants to sprout. Some conifers may seed in, but large numbers should not be anticipated in the moderately injured areas. The openings produced by

the severely burned pockets are fairly small at this time. Although an excellent seedbed existed shortly after the fire, shade from the surrounding live trees, as well as competition for moisture may limit the survival of any conifers that seed in. The openings will gradually enlarge over the next few years but conditions for conifer seed germination will deteriorate rapidly. After conditions stabilize, there should be some scattered individuals and small groups of conifers left alive.

In the lightly burned areas some scattered trees were killed directly by the fire. Additional trees were nearly or completely girdled at the base and will fade as the weather warms. Some scattered trees were also injured severely enough that they will be very susceptible to attack by bark beetles or flatheaded borers. Most of these attacks will result in the loss of single trees. A possible exception would be areas which are predominantly ponderosa pine. If a weakened pine is successfully attacked by western pine beetles, the successful beetles will release a pheromone which will attract other western pine beetles to the area. Other ponderosa pine within about 20 feet may also come under attack and result in a group kill of several to 30 or more trees. The size of a group kill will depend on the number of beetles attracted, proximity of ponderosa pine to the initial tree under attack, other tree species or natural features that break up a stand, general vigor of the stand and probably other unknown factors.

The net effect in the lightly burned areas should probably be neutral. The scattered mortality and small groups of trees killed should reduce competition and eventually increase growth and vigor among the survivors. On the other hand, many of the live trees have been wounded to one degree or another by basal scorching and may take years to fully recover. The situation should stabilize in a few years and the lightly burned areas should be in reasonably good health for unmanaged stands. Within a few decades, the effects of increasing basal area, increasing dwarf mistletoe infections and increasing tree age will all tend to decrease growth and vigor.

The probable events portrayed for the No Action alternative in the burned areas were all based on the premise that a major fire is a rare event which is unlikely to reoccur in the foreseeable future. Considering the amount of fuel in the area, the historical fire pattern that can be reconstructed, and the fate of nearby areas which have burned in the recent past, it seems most probable that if left alone the area will probably reburn within 1 to 3 decades.

Dead trees left standing after a burn will deteriorate at a predictable rate. Table 1 was derived from the expected rate of deterioration of four conifer species. It gives the minimum dbh of trees which will meet 25% or 33% utilization standards and also have a sound core at least 6 inches diameter. When using Table 1, there are some points to consider:

1. The Grider Creek drainage burned in September, 1987. September, 1988 will be one year after the burn; September, 1989 will be two years after the burn.

2. Some stems smaller than those listed in Table 1 will still technically have over 25% sound material (see Figure 2). The diameters in Table 1 were truncated at the point where the sound wood reached 6 inches because a cylinder of 5.7 inches is the smallest diameter that will encompass a 4 x 4 inch cant. If biomass or fiber are included in the intended mix of the products either

smaller diameters can be considered salvageable or larger diameters will be salvageable for a longer period of time.

3. The information in Table 1 and Figure 2 is based on some broad averages. Specific conditions which can vary widely within a single drainage may retard or advance the rate of deterioration.

A. High elevation sites and dry sites tend to retard the rate of deterioration by insects and fungi. Moist sites and warm temperatures increase the rate of deterioration. Aspect may be important.

B. Tree species and size influence the rate of deterioration, but age and growth rate are also important. Old growth timber often has considerable heartwood, which is resistant to decay, as well as narrow growth rings which also increase the resistance. Young trees tend to have a lot of sapwood, and fast-growing trees have wide rings which makes them less resistant to decay.

C. The base of a fire-killed tree is generally more moist than the rest of the tree and deterioration will be most rapid at that point. At 3 to 5 years after the burn (Sept. 1990-Sept. 1992) the severely burned stands will begin to break apart. This may affect attempts to salvage material after that point. Standing trees which are weak at the base may affect worker safety and jack-strawed trees on the ground may be difficult to retrieve or may limit access.

Alternative B - RECOVERY PROJECTS

This alternative would only consider recovery projects for the area. Erosion control structures, sediment traps, revegetation, maintenance/enhancement of fisheries habitat and maintenance/enhancement of water quality would be the key factors.

In the lighly burned areas there would probably be few projects that would affect the vegetation and the prognosis would remain the same as the No Action alternative. In the moderately and severely burned areas the activity that has the greatest potential to alter the outcome is revegetation. If the vegetation which is seeded or planted consists of native trees, the timetable for the prognosis portrayed for alternative A would be speeded. If the revegetation consisted largely of seeding native or exotic grasses, the time table would be delayed because the grass will initially out-complete tree seedlings for moisture and later will prevent conifer seed germination. Water yield should be higher with a grass forb cover than with native brush and trees. Some fisheries, however, are dependent on temperature modifications and organic input produced by native forest.

Alternative C - SALVAGE - NO ROADING

Alternative C would only allow timber harvest of fire killed timber; no green timber would be considered. Harvesting would take place from existing roads. No new road construction would be considered. Mitigation may include KV and other recovery projects identified in Alternative B.

Lightly burned areas would probably not be entered, or only marginally impacted, so the outcome would be the same as alternative A. If there are any scattered green trees left in severely burned areas after the fire-killed timber is salvaged, a large proportion of them should be expected to die over a period of

several years. Mortality will not be quite as severe around the edges of the severely burned areas or within the moderately burned areas, but will still be substantial and occur over a protracted time period. Removal of the fire-killed timber would probably cause some soil disturbance which has the potential to expose a suitable seedbed for conifers. Some of the surrounding green timber which could provide seed will also provide a source of dwarf mistletoe to infect developing conifer seedlings. Because the area which could be treated from the existing roads is a small fraction of the total area, much of the area would be left with heavy fuel loads. The probability that the area would burn again within the forseeable future is fairly high.

Alternative D - SALVAGE - MINIMUM ROADING

This alternative is the same as Alternative C except that this alternative explores a moderate amount of new road construction (6 miles).

The outcome of this alternative is similar to that of alternative C except that more area would be treated. Assuming that 1,000 feet would be treated on each side of the entire length of the 6 miles of new road (an overestimate), this alternative would treat an additional 10% of the affected area beyond what alternative C would treat. When viewed from the standpoint of the entire affected drainage, there is probably no significant difference between alternatives C and D on most systems.

Alternative - E - SALVAGE - EXTENSIVE ROADING

This alternative is the same as Alternative C except that it takes a look at roading more extensively and develops a transportation system that access more salvage volume for conventional systems (28 miles).

Because this alternative is limited to the salvage of fire-killed timber, it would have little impact on the current insect and disease situation. Impacts on the future situation would come from green trees left after the salvage. Douglas-fir and white fir infected with dwarf mistletoe may serve as a source of infection for future stands. White fir with basal wounds caused by fire or machinery can be infected with annosus root disease. While stands which regenerate after this alternative is implemented may have some insect and disease problems, they probably have less chance of being destroyed by a subsequent fire than those which would develop under alternatives A, B, C or D. Depending upon the time that this alternative is implemented, there is the potential to remove or treat a considerable portion of the dead fuel in the drainage. If only dead trees were removed in 1988 or 1989, some additional trees could be expected to die from various combinations of fire injury, drought stress and beetle attacks after the logging is completed. If the roads are completed early, additional mortality may be recovered as salvage. By 1990, however, the wood in the original fire-killed trees will have deteriorated to the point that only the largest trees could be salvaged for the timber value. Unless there are markets for biomass or low quality fiber, it would take a considerable investment to reduce the quantity of dead fuel after the trees have been dead for several years.

Alternative F - REGENERATION/SALVAGE - NO ROADING

The alternative provides for the harvest of fire killed timber and the harvest of green timber associated with those stands of dead timber. No all green stands of timber would be harvested. Primary focus here is to leave healthy

stands of timber or plantations. No new road construction would be done under this alternative. Mitigation may include KV funded projects as well as recovery projects identified in Alternative B.

This is a variant of alternative C which additionally removes some associated green trees. It should convert the severely burned areas which are accessible into plantations. The moderately burned areas which are accessible will probably either be cleared for plantations or become shelterwoods. Assuming that green trees left standing within or adjacent to the new plantations do not have dwarf mistletoe, and that site preparation is adequate, the resulting plantations should be fairly healthy. As with alternative C, a small percentage of the total area would be treated while the remainder would have heavy fuel loads.

Alternative G - REGENERATION/SALVAGE - MINIMUM ROADING

Alternative G is identical to alternative F in silvicultural practices except that it develops a minimum number of miles of road to harvest timber (6 miles).

As with alternative F, this would probably result in healthy plantations if the islands of green trees and the edges of green stands are sanitized. A relatively small percentage of the area would be treated while the remainder would still have heavy fuel loads. Similar areas which have burned have still had enough fuel after two decades to support another large fire. Some areas which reverted to brush after a fire are still brushfields after 6 decades. Basically, unless fire can be prevented in the entire drainage for an entire rotation, any investment in scattered plantations is likely to be lost.

Alternative H - REGENERATION/SALVAGE - EXTENSIVE ROADING

This alternative is similar to alternative F. However, this alternative develops a more extensive roading system to harvest more timber with conventional systems (28 miles).

Assuming that obviously diseased green trees are removed or treated, that there is adequate site preparation, and that gophers are controlled where necessary, this alternative has the potential to convert many of the severely and moderately burned areas to healthy plantations. Enough area might be treated to significantly reduce the fire hazard in the drainage. As discussed for alternative E, the time of implementation has considerable influence on the amount of fire-killed material that can economically be removed.

Alternative I - MAXIMUM TIMBER HARVEST

Alternative I takes a look at the options for harvesting timber in the entire roadless area. Salvage of fire killed timber, sanitation of diseased stands, regeneration of overmature stands, and other green timber harvest would be explored. Road construction would most likely develop the entire drainage at this time to make future management activities not only feasible but cost effective. Mitigation may include KV funded projects as well as recovery projects identified in alternative B.

This alternative has the highest potential to produce healthy stands and plantations, reduce the hazard of wildfire and eventually insure a stable, high quality water yield. Within the immediate future, the amount of timber removed may not be much larger than alternative H. A high priority would be to remove

fire-killed trees while the material still has enough value to pay for the operation. An adequate road system would allow for salvage of trees which die following the burn. Significant amounts of annual mortality should be expected in and around the severely and moderately burned areas, at least through the early 1990's. Although the lightly burned areas contain stands which have diseases, are overstocked or are overmature, most are healthy enough to survive another couple of decades with only some scattered mortality. These areas could be deferred until the more severely impacted areas have been regenerated. Although this alternative has the potential to disturb the greatest amount of the drainage, it offers the most rapid means of returning the area to a healthy, forested condition.

Alternative J - ECONOMICS

In the Economic alternative the focus would be to maximize the dollar outputs to both local and national economies. All timber harvest, road construction and recovery projects would be looked at for cost effectiveness and the alternative would reflect those projects that had the highest dollar return.

If all projects are examined for cost effectiveness based on current economic conditions and the available technology, some useful projects would be assigned a low priority. It is difficult to assign a dollar value to some amenities. With the passage of time and the deterioration of dead timber, returns from any project dependent on this resource would diminish. Some projects which are feasible shortly after a burn become unfeasible after several years, both from a standpoint of recovery of wood, as well as vegetative changes. Selection of the No Action alternative in some previous burns, whether consciously or by default, have resulted in brushfields which have persisted for over 6 decades. The economic conditions, resource demands and available technology of the future are likely to be different from the current ones, while future foresters will have to cope with the results of decisions being made today.

III. Specific management activities to reduce impacts of insects and diseases.

Some of the techniques listed below may be appropriate to achieve management goals under a specific set of circumstances. None should be considered a blanket prescription for the entire area.

1. Drop surplus dead trees before regenerating sites. Dead trees will eventually decay and fall. Trees over 10 inches dbh have the potential to break seedlings or saplings, or open entry courts for decay fungi by damaging bark as they fall. Dead trees over 10 inches dbh not needed for wildlife or other purposes should be dropped or otherwise removed before sites are regenerated.

2. Plant appropriate mixture of seedling stock. Many future problems can be avoided by planting stock from the appropriate seed zone and elevation. Some insects and diseases are host specific. Planting a mixture of species appropriate to the site will retard the spread of some organisms and will limit the magnitude of some others.

3. Avoid leaving trees infected with dwarf mistletoe. The major dwarf mistletoe species present are white fir dwarf mistletoe and Douglas-fir dwarf mistletoe. These species are host specific. If host seedlings are to be planted, it would be easiest to drop or remove infected overstory trees prior to planting. If infected overstory trees need to be retained for other objectives, there are several alternatives to produce relatively healthy regeneration. On

some sites it is possible to plant non-host seedlings, although this does not prevent host seedlings from becoming established naturally and later being infected. Because seedlings under 3 feet in height and less than 10 years of age rarely become infected, it is possible to underplant with host species and still have a clean plantation if the overstory trees are removed or killed within 10 years after seedling establishment. If the infected trees need to be left standing for wildlife habitat, several methods are available to kill the overstory trees, and the dwarf mistletoe infecting them, without felling the trees. Girdling will eventually kill trees, although it may take as long as four years for the trees to die. Girdled conifers usually die because they are attacked by bark beetles. While there is no danger of starting an outbreak in this way, it should be understood that this technique is somewhat non-selective. Because the beetles attacking the girdled tree will release an aggregating pheromone to draw additional beetles into the area, other host trees within 20-30 feet from the tree under attack will also be at risk even if they have not been girdled. A variation of this technique which would reduce the length of time needed to kill trees would be to place bark beetle pheromones directly on the bole of designated trees. Synthetic pheromones are available for several of the bark beetle species capable of killing pines and Douglas-fir. If applied at the proper time of year, pheromones should bring about tree death within a season, but as with girdling, nearby trees of the same species may be at risk. A technique which offers many advantages is the use of certain silvicides. They cause rapid death of the treated tree, will work with almost any tree species, will tend to kill or reduce breeding success of attacking bark beetles, and some will induce resinosis in the lower part of the treated bole which will retard deterioration and lengthen its lifespan as a wildlife tree. The use of silvicides would be subject to the same administrative procedures as other herbicides.

4. Plant white pine blister rust resistant sugar pine. Average collections of sugar pine seed from the Grider Creek area would probably show less than 1% resistance to blister rust. While there may be some low level of natural resistance and some other trees might escape infection long enough to produce commercial size trees, it would probably be a waste of time and resources to use an average collection of sugar pine seed for more than 10 percent of the planting mix. If blister rust resistant sugar pine seed from that seed zone is available, it would be a good candidate to use in planting mixtures on appropriate sites.

5. Treat green pine slash. If pines with some green foliage are cut, the slash from about 3 to 10 inches diameter could be used as breeding material by pine engravers. The major threat would be to living pines located within about 1/4 mile which are also desireable to retain. Assuming there is some resource in the area to protect, the most feasible method of modifying green pine slash in a timber sale is to lop all branches and buck the boles and large stems into the shortest pieces possible. If the stem and branch pieces are placed flat on the ground in full sunlight, the top of the pieces becomes too warm for pine engraver breeding and the part in contact with the soil will go sour. It is also possible to burn the slash, however, during the warm parts of the year pine engravers may complete their life cycle in less than 2 months. They may emerge before the slash is fully dry and fire restrictions may prevent burning before they emerge.

6. Avoid killing oaks. In California, Armillaria root disease usually causes only limited mortality of small size conifers in the root zone of an oak which suddenly dies. This has been seen in areas where oaks were purposely killed and

the area was then planted with conifers. The fungus is always present on the roots of oaks. If the tree suddenly dies, the fungus will build up on the food base of the roots and may kill small conifers within the root zone. It will not move out of the root zone but may remain active for 5 to 15 years. If oaks are allowed to sprout, or decline naturally, Armillaria does not build up. In areas which are to be regenerated with conifers within about 5 years, it may be prudent to avoid killing oaks during road construction, harvesting, slash burning or site preparation.

7. Protect high value pines. Under certain circumstances the value of an individual tree may quite high if it remains living. Examples include known nest or roost trees of key wildlife species, identified genetically superior trees, seed trees of a source in short supply, historical trees or trees with a high recreational or aesthetic value. If a high value pine has a temporary, reversible stress such as fire scorch or drought, it can be protected from attack by bark beetles for a period of up to a year by a single application of a registered insecticide to the lower 30-35 feet of the bole. Because the application is usually done with a truck-mounted hydraulic sprayer, this technique is normally limited to situations within 200-300 feet from established roads. There are ways of treating more remote trees if the added cost and labor are warranted. If reasonable care is used during application and mitigating techniques such as tarps around the tree base to intercept insecticide splash are used, the treatment will have little environmental impact.

IV. Probable adverse environmental effects that cannot be avoided.

Erosion is a natural process that occurs constantly. The rate of erosion can be altered by natural processes and human activities. The September, 1987 burn in the Grider Creek drainage removed tree crowns, surface organic layers and in some cases even tree roots. This should affect the quantity and quality of the water yield, as well as the rate of erosion. Future water quality and erosion rates will depend on the length of time until the area burns again and the intensity of the next burn. The same lightning storms which caused the Grider Creek drainage to burn also reburned portions of the Haystack burn of the 1950's and the Hog burn from 1977. Some of these areas which burned a second time within a relatively short period of time were hot enough to consume all vegetation and organic matter, fuse the surface of the soil and create a water repellant layer in the soil. Removal of fuel by salvage logging has some potential to lower the intensity of future burns. Although havesting, and particularly roading, are very likely to increase erosion and sedimentation in the near future, they offer the most rapid means to return the area to a forested condition and provide long-term stability.

If you need additional input on this subject, please contact either Dave Schultz or James Allison directly at 415-556-6520.

JOHN NEISESS
Program Leader
Forest Pest Management

FS-6200-28(7-82)

Table 1

MINIMUM DBH OF SALVABLE MATERIAL AFTER BURNS

Extracted From: Kimmey, J. W. 1955. Rate of deterioration of fire-killed timber in California, Circular No. 962, USDA. 22p.

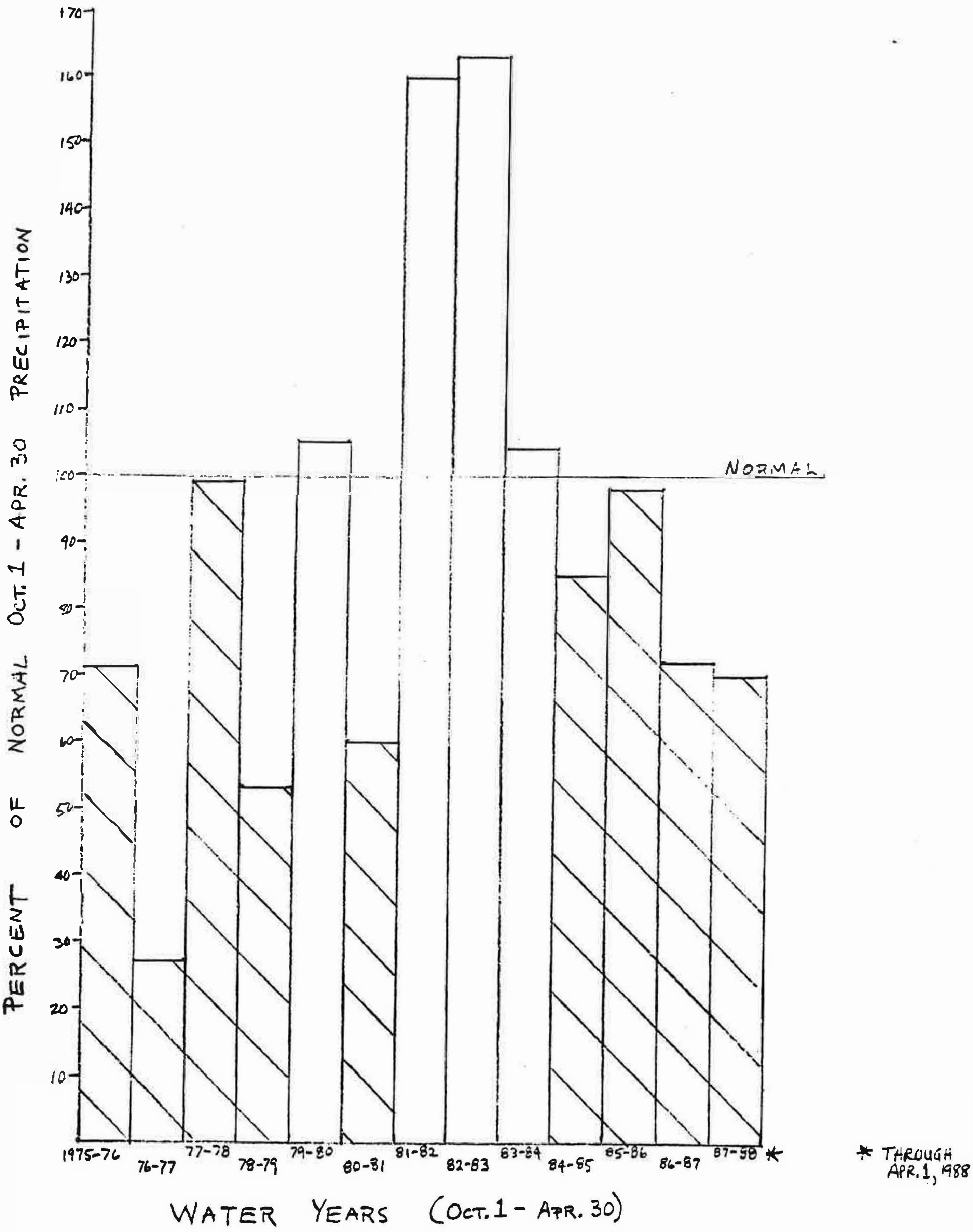
A. Minimum 25% gross board foot volume, 6 inch sound core.

	Species	White fir	Douglas-fir	Sugar Pine	Ponderosa Pine
		dbh	dbh	dbh	dbh
	1	10+inches	10+inches	10+inches	10+inches
	2	22	16	16	22
	3	26	16	18	36
YEARS	4	38	16	20	44
AFTER	5	N/A	16	20	60
BURN	6		18	22	N/A
	7		18	24	
	8		18	26	
	9		18	28	
	10		18	30	

B. Minimum 33% gross board foot volume, 6 inch sound core.

	Species	White fir	Douglas fir	Sugar Pine	Ponderosa Pine
	1	10+inches	10+inches	10+inches	10+inches
	2	26	16	16	32
	3	34	16	20	46
YEAR	4	N/A	16	24	60
AFTER	5		16	26	N/A
BURN	6		18	30	
	7		18	34	
	8		18	40	
	9		18	46	
	10		20	60	

FIGURE 1. OCTOBER 1 - APRIL 30 PRECIPITATION AT HAPPY CAMP R. S. IN PERCENT OF NORMAL



SOURCE: STATE OF CALIFORNIA - RESOURCES AGENCY. DEPT. OF WATER RESOURCES.

FIG. 2 DETERIORATION OF FIRE-KILLED TIMBER

DATA FROM: KIMMEY, J. W, 1955